content of the plant. The elements, the amount of which present in the nutrient solutions was varied, were calcium, magnesium, potassium, phosphorus, and nitrogen. The plan was to reduce the amount of these elements present to the lowest concentration that would allow the production of grain. This concentration would be below that required for the normal development of the plant, and it was thought that in such conditions the effect of the elements on the composition of the plant would be more strikingly brought out. Aside from the greatly reduced calcium or phosphorus content, when the amount of these elements in the respective nutrient solutions was reduced, the most striking results obtained were the low calcium content of the plants of the low phosphorus series and the low nitrogen series, and the high phosphorus content of the plants of the low calcium series and the low nitrogen series. Potassium and magnesium seemed to have little effect on the calcium and phosphorus content of the plant. Climatic factors, on the other hand, were shown to have a decided effect on the composition of the plant. A good bibliography is added.—S. V. EATON.

Alkali soils.—The hardening of irrigated land has been studied by SCOFIELD and HEADLEY,[16] who conclude that neutral salts of sodium as well as the carbonate, "black alkali," may produce hardening of the clay component of soils. The results are about the same, whether sodium-containing water is used on good soils, or whether pure water is used on salty soils; in either case the soil will harden seriously on drying, and become somewhat impervious to water. The theory advanced to explain the action of sodium on clay is that the sodium replaces other bases on the surface of the particles, and becomes in part sodium silicate. This hydrogel coating increases the effective size of each particle, reduces the porosity of the soil, and greatly retards water percolation through it. On drying, the colloidal gel cements the particles together, whence the hardness of these soils. If enough calcium or aluminium is present, however, the harmful action of sodium is obviated. When irrigation water contains more Na and K together than Ca and Mg, it is likely to cause hardening. The Colorado River and its lower tributaries contain too much of the hardening salts. The authors think injury to irrigated land may be avoided by treatment of irrigation water or land with soluble calcium or aluminium salts.—C. A. SHULL.

Nitrogen fixation by green plants.—WANN[17] presents some interesting results of experiments showing that members of the Chlorophyceae can utilize the uncombined nitrogen of the atmosphere. Seven species exhibited this

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[16] SCOFIELD, C. S., and HEADLEY, F. B., Quality of irrigation water in relation to land reclamation. Jour. Agric. Res. **21**: 265–278. 1921.

[17] WANN, F. B., The fixation of free nitrogen by green plants. Amer. Jour. Bot. **8**: 1–29. *pl. 1. fig. 1.* 1921.

power when grown on mineral nutrient agar containing a nitrate and glucose. There was no fixation when nitrogen was supplied in the organic form, and with a nitrate present but no carbohydrate, the amount of fixation was not marked enough to be conclusive. There seemed to be some fixation in the latter case, the lesser amount being due, perhaps, to the much decreased growth where the carbohydrate was omitted. One species seemed to have the power of denitrification as well as nitrogen fixation. The amount of nitrogen fixed by the algal species used compared favorably with the amount recorded by other investigators as fixed by the nitrogen fixing bacteria. The results recorded in this paper are contrary to the generally accepted view as to the ability of green plants to make use of free nitrogen. The possibility of green plants possessing this power of nitrogen fixation, however, is of such great interest both scientifically and economically that the work of WANN should be the stimulus for much more work along this same line.—S. V. EATON.

Variation in stomata and hydathodes.—In a study of the number of stomata per sq. mm. upon leaves of *Campanula rotundifolia* borne upon different parts of the same plant and upon the leaves of plants grown under different conditions of habitat, Miss REA[18] found some interesting variations. In general there was an increase in number from the lower to the higher position of the leaf upon the shoot, and an increase with conditions of increasing dryness. Such increase was least upon the under surface of leaves on different portions of the stem of the same plant. It is suggested that the increased number upon sun shoots compared with those developed in the shade is due to increased photosynthesis, although no causal connection is established. It would be desirable to know the connection between the size of the epidermal cells and the number of stomata, but this information is not given. Groups of hydathodes were found on the upper surfaces of all leaves examined, the number per leaf decreasing from the base to the apex of the shoots.—G. D. FULLER.

Water relations of Pinus and Leucadendron.—Following methods devised by FARMER, the water conducting power of the wood of *Pinus pinaster* and *Leucadendron argenteum* has been measured by AITKEN,[19] and a comparison instituted between transpiration and the rate of water transmission. The rate of transpiration was higher in *Pinus*, both per twig and per unit area, than in *Leucadendron*, as was also the ratio of transpiration to transmission. From the data obtained it would seem that the wood of *Pinus* is capable of transmitting a limited amount of water which it utilizes with a very small margin of surplus.—G. D. FULLER.

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[18] REA, MARGARET W., Stomata and hydathodes in *Campanula rotundifolia* L., and their relation to environment. New Phytol. **20**:56–72. *figs.* 6. 1921.

[19] AITKEN, R. D., The water relations of the pine (*Pinus pinaster*) and the silver tree (*Leucadendron argenteum*). Trans. Roy. Soc. So. Africa **10**:5–19. 1921.